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Medical Education and Path to Residency in Ophthalmology in the COVID-19 Era: Perspective from Medical Student Educators

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The coronavirus 2019 (COVID-19) pandemic has presented unprecedented challenges. Our clinical practices and resident training programs continue to implement changes in response to evolving public health needs.^{1,2} In parallel, a need exists to transform medical student education in ophthalmology and to think critically about the medical student path to residency in ophthalmology. Since April 2020, a group of medical student educators from New York, an early American epicenter of the pandemic, has met virtually to collaborate and share resources. Additionally, on the national level, the Association of University Professors of Ophthalmology (AUPO) Medical Student Educator Council meets regularly to guide national education in ophthalmology. These groups have developed a consensus on the way forward using national guidelines^{3,4} and have devised multiple strategies to maintain and expand medical student engagement within our specialty.

Impact on Medical Student Clinical Training

Exposure to ophthalmology in medical school has been declining over the past few decades and has plateaued since 2014, with fewer than 20% of medical schools requiring an ophthalmology clerkship.^{5,6} The COVID-19 pandemic has impacted the ophthalmology curriculum further by limiting opportunities for core ophthalmology clerkships and

elective rotations, as well as essentially eliminating so-called away rotations.

In response, the medical student educator community proposed the creation of virtual clerkships and electives, as well as the use of online curricula. Pre-existing guidelines endorsed by the AUPO and the American Academy of Ophthalmology (AAO) on what every graduating medical student should know about ophthalmology⁷ frame the learning objectives of virtual clerkships. Sharing of curricula and resources interinstitutionally has augmented the quality of content that can be delivered and allows individual institutions to tailor resources to their needs. In addition, the AAO started a webinar series to address training during the pandemic, which included a session on resources for remote learning.⁸ The creation of a nationwide standardized curriculum, which may use online content developed previously and available on the AAO website,⁹ would increase access to quality content further for students of all backgrounds and institutions,⁶ even after the COVID-19 pandemic.

Moving forward, in addition to online didactics, virtual electives can incorporate telemedicine, remote observation, virtual cases, and simulation. Students can participate in telehealth visits by collecting histories, reviewing records, and charting their findings. History-taking and physical examination skills can be developed by having fellow students act as simulated patients, and physical examination skills can be practiced on students' roommates or significant

others. Interactive patient cases and anatomic figures, such as on the AAO medical student website, approximate clinical encounters.^{10,11} Finally, students can acquire direct ophthalmoscopy skills via patient simulators and can experience ophthalmic microsurgery via surgical simulators. Increased emphasis will be placed on self-directed learning throughout, which will equip students with a skill set key to patient care and board certification and will cultivate a mindset toward lifelong learning. Collectively, these virtual experiences may afford more interactive learning than was possible previously in the traditional clerkship model.

During the pandemic, we are embracing the use of virtual education to teach clinical ophthalmology, yet we recognize that virtual education cannot permanently replace in-person clinical electives. In-person ophthalmology electives enhance our ability to observe students and to evaluate clinical performance, including students' integration into the healthcare team, skill in interacting with patients, professionalism, and clinical and surgical skills. Electives in the postpandemic era likely will involve a hybrid model of virtual didactics, simulation, telemedicine, self-directed learning, and in-person clinical encounters. This new model provides students with a variety of experiences, including new opportunities in patient care and technical skill development, while limiting unnecessary face-to-face exposure. Providing a broad range of educational experiences also prepares our students to be versatile residents and clinicians as the future of medical practice transforms.

Impact on Prospective Applicants

The COVID-19 pandemic largely has eliminated or reduced opportunities for students to participate in clinical activity, to conduct research, or to volunteer in ophthalmology. This exacerbates existing challenges that they face in gaining exposure to our specialty, decreases mentorship opportunities, which may impact negatively the pipeline of future ophthalmologists,¹² and puts further stress on applicants hoping to demonstrate their potential as future residents.

At several of our institutions and across the nation, virtual initiatives have been successful in engaging medical students and promoting interest in our field. Many medical schools have increased virtual mentorship opportunities, including from department faculty and near peers. Ophthalmology interest groups have hosted interest panels successfully via video teleconferencing. Grand rounds and other live didactics, delivered remotely and later available online, are now more accessible than ever to medical students.

Nationally, a virtual ophthalmology mentorship program is currently under development to help introduce more medical students to ophthalmology while facilitating collaboration and mentorship across institutions (Andrea Tooley, e-mail communication, June 2020). In addition, a student-initiated webinar, led by matched students and ophthalmology educators on Twitter, recently occurred to address concerns from students without home ophthalmology departments about finding mentorship.¹³ In the

postpandemic era, the role of social media in highlighting educational and professional opportunities¹⁴ may be accelerated further.

Impact on Residency Application Process

Medical student advisors have tried to reassure prospective applicants that they will be considered in the context of the pandemic. Applicants will be affected in myriad ways not only this year, but also over the next several application cycles. Joint efforts between the AUPO and the AAO continue to address many of these issues, including a recent webinar involving department chairs, medical student education directors, and residency program directors that provided tips to prospective applicants on the upcoming residency application cycle.¹⁵ The impact on students will necessitate a reconsideration of how information on the residency application process is shared with students and how candidates are evaluated.

Changes to the residency application process related to COVID-19 have increased the need for frequent and effective communication with students. Enhanced communication strategies may include creating a master list of application-related internet resources for students or initiating group and individual virtual mentoring sessions designed to help students navigate curriculum and application process changes.

Many key factors in residency selection, such as United States Medical Licensing Examinations and clerkships, have profoundly changed. United States Medical Licensing Examinations have been canceled or rescheduled for many students, and step 1 results will soon become pass or fail. Clerkships have been shortened, cancelled,¹⁶ offered virtually,¹⁷ postponed, or a combination thereof at many of our institutions, creating a ripple effect on other parts of the curriculum (i.e., shortened scholarly research, elective time, or both). Some institutions have moved to pass-or-fail clerkship grading and others have modified grading standards. The National Board of Medical Examiners subject examinations ("shelf exams") have moved temporarily to remote administration based on an honor system. Additionally, the Medical Student Performance Evaluation letter will be delayed this year, although it may offer more insight for future applicant classes by providing information on grading changes made during the pandemic.

Furthermore, basic and translational research opportunities have been halted temporarily but indefinitely, prompting some students to consider an additional research year to explore opportunities to bolster their applications. However, an additional research year in the context of paused prospective research ultimately may not prove beneficial, unless research pauses are lifted early in the course of the year. The financial considerations of taking a year out also must be considered for our students. In those instances where a robust mentorship relationship has been formed, recommendation letters will take on special importance.

Many or all interviews will be conducted virtually, which may influence program perceptions of an applicant, but just as

importantly, applicant perceptions of a program. Applicants no longer will be able to learn about programs through pre-interview receptions or informal conversations with current residents. These may be replaced by video tours created by marketing experts and choreographed videoconference chats and interviews. However, current resident satisfaction, geographic area, and interview day collegiality were top factors in ranking decisions based on a multiinstitutional survey of applicants (Freedman R, et al. Resources, reliability, and factors important to ophthalmology applicants. Abstract presented at: Association of University Professors of Ophthalmology Annual Meeting; January 29–February 1, 2020; Rancho Mirage, CA), so efforts must be made to give students information on these aspects as well.

Remote interviews also may allow for an increase in the number of interviews an applicant may attend, no longer being limited by travel, lodging, and associated costs. If the top applicants accept more interview slots, this may have the unintended consequence of crowding out other applicants. In an effort to prevent this while still providing applicants a sufficient number of interviews to match based on historical data,¹⁸ the AUPO will limit applicants to 20 interviews for the 2020–2021 application cycle. In addition, a new centralized interview scheduler will be implemented via the SF Match that will help applicants to track their interviews and schedule up to 2 virtual interviews per day. As a result of all these changes, applicants should be mentored so that they are aware of the impact of virtual interviews and are equipped with the skills needed for a successful virtual interview. The AAO/AUPO Minority Ophthalmology Mentoring Program has been developing tools to enhance virtual interviewing skills. These techniques have been shared with the AUPO education community to help provide best practices in this area to all applicants and stakeholders.

In conclusion, the COVID-19 pandemic has required rapid adaptation to continue to educate our students, expose them to ophthalmology, and recruit them into the field. As a result, the quality and availability of ophthalmology educational content has grown substantially, which may have long-lasting positive effects on medical student training and the path to ophthalmology residency. Our groups encourage programs to implement changes—both temporary and permanent—as soon as possible, because all of these initiatives require much time and care to implement. In the postpandemic era, programs should be prepared to transition to virtual offerings at a moment's notice, should the need arise because of another pandemic. Although this pandemic has pushed our field to engage students virtually, we also must be vigilant that the best part of our small field—high-quality human engagement—is not diminished permanently.

References

1. Olivia Li JP, Shantha J, Wong TY, et al. Preparedness among ophthalmologists: during and beyond the COVID-19 pandemic. *Ophthalmology*. 2020;127(5):569–572.
2. Chen RWS, Abazari A, Dhar S, et al. Living with COVID-19: a perspective from New York area ophthalmology residency program directors at the epicenter of the pandemic. *Ophthalmology*. 2020;127(8):e47–e48.
3. The Coalition for Physician Accountability. Final report and recommendations for medical education institutions of LCME-accredited, U.S. osteopathic, and non-U.S. medical school applicants. <http://www.nrmp.org/coalition-physician-accountability-documents/>; 2020. Accessed 29.02.20.
4. Association of University Professors of Ophthalmology. 2021 Ophthalmology match updates. <https://aupo.org/news/2020-05/2021-ophthalmology-match-updates>; 2020. Accessed 29.06.20.
5. Moxon NR, Goyal A, Giaconi JA, et al. The state of ophthalmology medical student education in the United States: an update. *Ophthalmology*. 2020;127:1451–1453.
6. Shah M, Knoch D, Waxman E. The state of ophthalmology medical student education in the United States and Canada, 2012 through 2013. *Ophthalmology*. 2014;121(6):1160–1163.
7. Graubart EB, Waxman EL, Forster SH, et al. Ophthalmology objectives for medical students: revisiting what every graduating medical student should know. *Ophthalmology*. 2018;125(12):1842–1843.
8. American Academy of Ophthalmology. Ophthalmology learning during COVID for medical students, residents, and educators. <https://www.aao.org/annual-meeting-video/ophthalmology-learning-during-covid-medical-studen>. Accessed 26.06.20.
9. American Academy of Ophthalmology. Ophthalmology resources for medical students. <https://www.aao.org/medical-students>. Accessed 11.06.20.
10. Horne A. Middle-aged man with red eye. https://aao-resources-enformehosting.s3.amazonaws.com/resources/Med-Students/Middle-Aged_Man_With_Red_Eye/story_htm15.html. Accessed 11.06.20.
11. American Academy of Ophthalmology. Interactive ophthalmic figures for medical students. <https://www.aao.org/interactive-figures>. Accessed 11.06.20.
12. Wong TY, Bandello F. Academic ophthalmology during and after the COVID-19 pandemic. *Ophthalmology*. 2020;127(8):e51–e52.
13. Ahmed H, Felsted D, Spurrier R, et al. Matching in 2021 amidst COVID-19. <https://transcripts.gotomeeting.com/#/s/edaaf2595bf1fd87bf0c6ff46a3c04faa2754efd4a118eba067a2400aa4d62af>. Accessed 26.06.20.
14. Schmuter G, Tooley AA, Chen RWS, Law JC. Social media in ophthalmology: the educational and professional potential for medical students. *J Acad Ophthalmol*. 2020;12(01):e41–e45.
15. American Academy of Ophthalmology, Association of University Professors in Ophthalmology. 2020 Advice for the ophthalmology residency match season. <https://www.aao.org/2020-match-webinar-questions>. Accessed 26.06.20.
16. Ferrel MN, Ryan JJ. The impact of COVID-19 on medical education. *Cureus*. 2020;12(3):e7492.
17. Theoret C, Ming X. Our education, our concerns: the impact on medical student education of COVID-19. *Med Educ*. 2020;54(7):591–592.
18. Siatkowski R, Mian S, Cullican S, et al. Probability of success in the ophthalmology residency match: three-year outcomes analysis of San Francisco matching program data. *J Acad Ophthalmol*. 2018;10(01):e150–e157.

Footnotes and Financial Disclosures

Financial Disclosure(s): The author(s) have made the following disclosure(s): L.R.D.G.: Royalties — Thieme.

P.S.R.: Expert testimony — Medical malpractice expert review

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